Quotient rule for exponents

Let's take a look at the quotient rule for exponents. This is the rule we use when we're dividing one exponential expression by another exponential expression.

The quotient rule tells us that we have to subtract the exponent in the denominator from the exponent in the numerator, but the bases have to be the same. Here's the rule:

$$\frac{x^a}{x^b} = x^{a-b}$$

Example

Use the quotient rule for exponents to simplify the expression.

$$\frac{x^4}{x^3}$$

The base of the expression in the numerator is x, and the base of the expression in the denominator is x, which means that the bases are the same, so we can use the quotient rule for exponents. We'll subtract the exponent in the denominator from the exponent in the numerator, keeping the base the same.

$$\frac{x^4}{x^3}$$

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$$x^{4-3}$$

$$x^{1}$$

$$x$$

Remember, the quotient rule works only with like bases, so

$$\frac{y^3}{x^2}$$

can't be simplified, because the base of the expression in the numerator is y and the base of the expression in the denominator is x. Because the bases aren't the same, we can't use the quotient rule.

We can still use the quotient rule if we have a negative exponent in the numerator, a negative exponent in the denominator, or both.

Example

Simplify the rational expression.

$$\frac{x^3}{x^{-2}}$$

It doesn't matter that the exponent in the denominator is negative. We can still use the quotient rule since the bases are the same, and subtract the exponent in the denominator from the exponent in the numerator.

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$$\frac{x^3}{x^{-2}}$$

$$x^{3-(-2)}$$

$$x^{3+2}$$

$$x^5$$

Let's do an example where we could end up with a negative exponent in the final answer.

Example

Use the quotient rule for exponents to simplify the expression. Write the expression with positive exponents.

$$\frac{x^5}{x^7}$$

The base of the expression in the numerator is x, and the base of the expression in the denominator is x, which means that the bases are the same, so we can use the quotient rule for exponents.

We'll subtract the exponent in the denominator from the exponent in the numerator, keeping the base the same.

$$\frac{x^5}{x^7}$$

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$$x^{5-7}$$

$$x^{-2}$$

To write this expression with only positive exponents, we can move the x^{-2} to the denominator, and change the exponent from negative to positive.

$$\frac{1}{x^2}$$

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